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Original Article

EFFECT OF DIFFERENT LEVELS OF NPK FERTILIZER MANAGEMENT ON MAIZE + GROUNDNUT (2:2) INTERCROPPING SYSTEM UNDER RAINFED CONDITION

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ABSTRACT

A field experiment was conducted during kharif season of 2008 and 2009 in the experimental farm of School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema Campus, Nagaland to evaluate the different levels of NPK fertilizer management in maize + groundnut intercropping system. The experiment was laid out in split plot design with three replications. The treatments comprised of F_1-Control (No NPK) F_2-, 100% NPK to maize and intercrop, F_3-100% NPK to maize,F_4- 100% NPK to maize + 50% NPK to intercrop, F_5-50% NPK to maize + 100% NPK to intercrop, F_6-50% NPK to maize and intercrop. Maize with groundnut (2:2) was found to be the best intercropping system recording better crop growth and yield attributes and higher grain and stover yields. Among the different fertilizer doses, application of NPK at 100% to both the crops was found to be the best fertilizer dose producing the highest crop growth and yield (37.53 q/ha). Maize equivalent yield increased significantly up to 100 per cent NPK doses applied to maize and groundnut. Application of 50 and 100 per cent NPK to maize and groundnut increased maize equivalent yield from 26.20 per cent to 47.74 per cent over control. Intercropping system involving maize with groundnut along with application of 100% NPK to both the crops increased pooled grain yield by 36.72 per cent over 50 per cent NPK to both the crops. Highest groundnut yield (9.32 q/ha) and benefit cost ratio of 2.54 was also recorded in the same treatment. On pool basis it was found to be the most economically viable cultivation practice registering the highest gross return and net return/ha and also recording the higher B:C ratio.

KEYWORDS: Maize, Groundnut, Intercrop, Nutrient Management, Yield

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INTRODUCTION

Maize is cultivated both in tropical and temperate regions of the world. The area under cultivation of maize in the world is 135 million hectares with the production of around 560 million tones. In India, maize is grown under varied soil and climatic condition from sea level to an altitude of 2500 meters or more. Maize is generally grown during Kharif in North India, but this crop has grown successfully in winter as well as summer (Patel et al., 1987). The total maize cultivated area in India is 7.59 million hectares with a production of 14.71 million tones and the average productivity is 1938 kg per hectare (Anonymous, 2007).

Most common advantage of intercropping is the production of greater yield on a given piece of land by making more efficient use of the available growth resources using a mixture of crops of different rooting ability, canopy structure, height, and nutrient requirements based on complementary utilization of growth resources by the component crops. Moreover, intercropping improves soil fertility through biological nitrogen fixation. Use of

legume increases soil conservation through greater ground cover than sole cropping and provides better lodging resistance for crops susceptible to lodging than when grown in monoculture. Of the two type of intercropping, additive series is growing of intercrop between the rows of main crop without any adjusting in the spacing of main crop whereas in paired series, the spacing of the main crop is reduced and equal opportunity is given to the intercrop for better growth. The crops are grown in pair of 2 in case of paired series. Legumes are known to fix atmospheric nitrogen, thus enriching soil fertility and helping to meet the N needs of cereals (Meena et al., 2007). Intercropping was originally practices as an insurance against crop failure under rainfed condition. It also limits weed growth, pest and disease infestation, economic use of N fertilizer due to association of legumes (Chaudhury, 1979, De and Singh, 1979). Stability of the crop yield can also be achieved in upland through crop substitution and intercropping. Thus, it is clearly justified that intercropping has been recognized as a beneficial system for crop production. It can provide substantial yield advantage as compared to sole cropping (Patel et al., 1987).

Nutrient management plays key role in sustaining the productivity of this system has still not been understood adequately as compared to sole cropping in terms of system efficiency, more so, regarding the concept of nutrient management where both crops have different growth habits and input management. De and Singh (1979) reported that the increasing level of nitrogen resulted in increased nitrogen uptake by maize. Luchsinger et al. (1999) reported that the yield of crop is increased with increasing level of phosphorus and nitrogen. Thakur et al. (1988) reported that baby corn increased significantly with increasing nitrogen application upto 150 kg/ha. Nitrogen uptake by plants increased significantly upto 150 kg/ha.

MATERIALS AND METHODS

A field experiment was conducted at the research farm of School of Agricultural Sciences & Rural Development, Nagaland University, Medziphema, during rainy (kharif) season 2008 and 2009 to study the effect of different levels of NPK management in maize + soybean intercropping system under rainfed condition. The soil of the experimental field was clayey loam and well drained, strongly acidic (pH 5.0), with low available N (244kg N/ha) and medium in available phosphorous (28.6kgP/ha) and potassium (198.32kgK/ha) and high organic carbon (1.89%). The experimental plot was located at an altitude of 310 m above mean sea level with geographical location at $25^0 45' 45''$ N latitude and $95^0 53' 04''$ E longitude. The experiment was laid out in split plot design replicated three times with two intercrop-maize + groundnut and maize + soybean as main plot treatment and six NPK levels as sub-plot treatments. The treatment consisted of F_1-Control (No NPK), F_2-100%NPK (both the crop), F_3-100%NPK (maize), F_4-100% (maize) +50% (intercrop), F_5-50% (maize) + 100% (intercrop) and F_6-50% NPK (maize & intercrop). Recommended doses of fertilizer for maize is 80:60:40 kg NPK (100%) and for groundnut is 20:60:40 kg NPK/ha (100%) in the form of Urea, Single super phosphate and Muriate of potash. The climate during both the years of experimentation was normal with 1850mm rainfall during 2008 and 1900 mm rainfall in 2009 respectively.

Maize variety 'Ganga' and groundnut variety 'JL 24' was sown with the onset of monsoon during July. Maize and soybean was grown intercropped with 2:2 row ratios in paired row of 30cm x 30cm for both the crop maize and groundnut. Full dose of NPK was applied as basal as per the treatment for soybean crop whereas, half of N and full dose of P and K was applied as per the treatment to maize crop at the time of sowing and remaining half made two split and applied at knee high and flowering stage between the two rows of maize crop. All other agronomic and cultural practices were kept standard and uniform for all the treatments. Maize was harvested by removing cobs from plant at physiological maturity in

the month of September, then dried the cobs in sun and removed the seeds with the help of maize Sheller. The grains were cleaned dried properly before taking final weight. Groundnuts were harvested after yellowing and drying the plant by digging with the help of hand hoe in the month of October. Data on crop growth and yield attributes and grain yield of both the cops were recorded following standard procedure. Then cleaned and dried the kernals in sun. Maize equivalent yield was calculated on the basis of prevailing market price, based on yield of intercrop groundnut. Data collected were statistically analyzed by applying techniques of analysis of variance as described by Gomez and Gomez (2010). The significant differences were tested by 'F' test. Critical difference of different treatments and their interactions at 5 per cent probability level were calculated whenever 'F' test was significance.

RESULTS AND DISCUSSIONS

Growth, Yield Attributes and Yield of Maize

A perusal of data in Table 1& 2 would reveal that different levels of fertilizer recorded significant effect on growth and yield attributes of maize crop. Highest plant height (254.93cm), crop growth rate (1.97) was recorded with 100 per cent NPK to maize crop and the lowest plant height (212.5cm) and crop growth rate (1.21) was at control. Highest number of leaves (8.79), leaf area index (2..81) and land equivalent ratio (1.45) was recorded when 100 per cent NPK was applied to both the crops. Whereas, control recorded the lowest number of leaves (6.51), leaf area index (1.78) and land equivalent ratio (0.75). The results were in close conformity with the findings of Shivay and Singh (2000).

Application of 100 per cent recommended dose of fertility to maize and intercrop groundnut increased the pooled grain yield by 36.72 per cent over 50 per cent RDF to both the crops. Significant increase in grain yield of maize with increasing levels of fertilizer doses could be attributed to increased dry matter accumulation and dry matter partitioning in crop plant at increasing fertility levels. Highest yield attributes such as number of grains per cob (406) and test weight (241g) was recorded at 100 per cent NPK applied to both the crops. Maize equivalent yield increased significantly upto 100 per cent NPK applied to maize and groundnut. Application of 50 and 100 per cent NPK to maize and groundnut increased maize equivalent yield from 26.20 per cent to 47.74 per cent over control. On pool basis 38.18 per cent increase in B:C ratio was observed in 100 per cent NPK to both the crops.

Growth, Yield Attributes and Yields of Groundnut

Data (Table-3) reveled that growth parameters of groundnut was significantly affected by different fertility levels. Maximum plant height (108.87cm), number of leaves (71) per plant, number of branches (9.48) per plant and crop growth rate (1.02) was recorded when 100 per cent NPK levels applied to both the crops. Optimum supply of nutrients to groundnut might have enhanced meristematic activities in plants by stimulating cell division and elongation of cells which reflected in the increased plant height and LAI, which in turn provided greater leaf surface for better inception, absorption and utilization of radiant energy. Similar were the findings of Kapila (1989) and Maurya and Rathi (2000). Marked improvement in yield attributes such as pods per plant (44.68), seeds per pod (2.12), test weight (475.36g) at 100 per cent NPK levels to both the crops were recorded. On pooled basis 46.57 per cent increase in groundnut yield was observed with 100 per cent NPK levels to both the crops as compared to control. However no significant difference in harvest index was recorded due to different levels of fertilizers applied.

Table 1: Effect of Different Levels of Fertilizer on Growth Parameters of Maize Crop Grown Intercropped with Groundnut

Treatments	Plant Height (cm)	Number of Leaves	LAI	CGR (g/Plant/Day)	RGR (g/g/Plant)	LER
F_1-Control (No NPK)	212.50	6.51	1.78	1.21	0.057	0.75
F_2-100%NPK (both the crop)	249.48	8.79	2.81	1.90	0.057	1.45
F_3-100%NPK (Maize)	254.93	7.98	2.56	1.97	0.057	1.06
F_4-100%(Maize) +50% (IC)	250.67	8.22	2.49	1.83	0.057	1.26
F_5-50% (Maize) + 100% (IC)	243.83	7.34	2.38	1.66	0.054	1.11
F_6-50% NPK (Maize & IC)	239.22	6.69	2.23	1.72	0.057	0.98
SEm±	2.22	0.03	0.07	0.06	0.001	0.01
CD (P=0.05)	6.54	0.08	0.20	0.17	NS	0.03

Table 2: Effect of Different Levels of Fertilizer on Yield and Yield Parameters of Maize Crop Grown Intercropped with Groundnut

Treatments	Grain/ cob	Test Weight (g)	Grain Yield (q/ha)	HI (%)	Maize Equivalent Yield	B:C Ratio
F_1-Control (No NPK)	314.21	172.78	19.22	49.41	42.51	1.57
F_2-100%NPK (both the crop)	406.17	241.42	37.53	49.87	81.35	2.54
F_3-100%NPK (Maize)	363.09	215.73	30.11	49.46	56.58	1.91
F_4-100%(Maize) +50% (IC)	386.33	226.32	34.06	49.84	69.96	2.24
F_5-50% (Maize) + 100% (IC)	335.67	196.19	25.33	48.67	65.59	2.11
F_6-50% NPK (Maize & IC)	330.49	191.86	23.75	49.55	57.60	1.91
SEm±	0.10	2.73	0.40	0.15	0.54	0.02
CD (P=0.05)	0.29	8.05	1.18	0.44	1.59	0.05

Table 3: Effect of Different Levels of Fertilizer on Growth Parameters of Groundnut Crop Grown Intercropped with Maize at 2:2 Row Ratio

Treatments	Plant Height (cm)	Number of Leaves per Plant	Branches per Plant	LAI	CGR (g/plant /day)	RGR (g/g/plant)
F_1-Control (No NPK)	96.35	56.73	7.85	7.58	0.77	0.067
F_2-100%NPK (both the crop)	108.87	71.34	9.48	11.98	1.02	0.055
F_3-100%NPK (Maize)	102.13	60.82	8.24	9.73	0.78	0.058
F_4-100%(Maize) +50% (IC)	106.03	63.08	8.75	10.79	0.88	0.057
F_5-50% (Maize) + 100% (IC)	107.00	66.33	9.01	12.78	0.88	0.056
F_6-50% NPK (Maize & IC)	103.03	61.95	8.38	10.02	0.78	0.053
SEm±	0.90	0.07	0.02	0.18	0.043	0.006
CD (P=0.05)	2.65	0.23	0.05	0.53	0.12	0.017

Table 4: Effect of Different Levels of Fertilizer on Yield and Yield Parameters of Groundnut Crop Grown Intercropped with Maize

Treatments	Pods per Plant	Seeds per Pod	Test Weight (g)	Grain Yield (q/ha)	HI (%)	Duration of Crops
F_1-Control (No NPK)	35.10	1.71	411.33	4.98	33.20	124.98
F_2-100%NPK (both the crop)	44.68	2.12	475.36	9.32	33.00	127.14
F_3-100%NPK (Maize)	36.59	1.79	425.02	5.53	33.10	124.99
F_4-100%(Maize) +50% (IC)	38.02	1.85	445.52	7.90	33.03	126.35
F_5-50% (Maize) + 100% (IC)	42.50	1.94	466.76	8.77	33.19	127.16
F_6-50% NPK (Maize & IC)	37.38	1.82	433.44	7.23	33.03	125.99
SEm±	0.35	0.01	3.00	0.11	0.17	0.11
CD (P=0.05)	0.98	0.02	8.84	0.32	NS	NS

CONCLUSIONS

The study revealed that application of NPK levels 100 per cent to both the intercrops maize and groundnut recorded better results. Among the different fertilizer doses, application of NPK at 100% to both the crops was found to be the best fertilizer dose producing the highest crop growth and yield (37.53 q/ha). Maize equivalent yield increased significantly up to 100 per cent NPK doses applied to maize and groundnut. Application of 50 and 100 per cent NPK to maize and groundnut increased maize equivalent yield from 26.20 per cent to 47.74 per cent over control.

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